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STUDY ON THE BEHAVIOR OF BUILDING UNDER DIFFERENT SOIL CONDITIONS

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ABSTRACT

We are living in the society where the cost of the land is increasing exponentially, where people want to live at some height due to environment facts, hence developing the new era of living people moving in multi-story buildings. It is fairly acceptable that the soil condition of the site will affect the structure, not only on the sub-structure but also on super-structure too. Hence to know the behavior of the building under soil condition mentioned in the IS 1893:2002 (Part I), Using the ETABS 2016 v16.0.0. The analytical analysis was done using the very severe seismic condition (zone 5) and static wind loads using IS 875:1989 (Part III). An attempt is made to compare the result from the same building subjected to change of soil condition.

Key words: Reinforced Cement Concrete, Soil Condition, Response Spectrum Analysis, E-TABS.

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1. INTRODUCTION

Engineering reaches to the top the sky, to the deep of oceans, where always we have to check for the stability of soil, hence to keep that in mind the one can proceed with some guideline and provisions. We know that the soil property will affect the design of the structure hence to get the response of the structure under the lateral forces that is seismic and the wind, a building of G+13 taken and a result is expected to compare. The design of such building is usually governed by the earthquake as the very severe condition of the earthquake that is zone V.

Classification of soil:

Rock or Hard Soil: Well graded gravel and Sand mixtures with or without clay binder and clayey sands poorly graded or sand-clay mixtures, whose N (standard penetration value) should be above 30

Medium Soils: All soils with N between 10 and 30, and poorly- graded sands or gravelly sands with little or no fines

Soft Soils: All soils other than whose N is less than 10.

Lateral force attracted by the shear wall, also its depends on the position of the shear wall (Ravikanth Chittiprolu, 2014) (1), (K. Shaiksha, 2014) made a study on the behavior of the building under the hard (2) and soft soil (3) under different seismic zones, using the Infill wall and the bracing system. They conclude that the displacement is less in the case of the Infill wall system. (Anila Anna Samson, 2014) (4), had done the non-linear study on the core and L- shaped shear wall, whereas the core type of shear wall is showing less displacement compare to the L-shaped one. Earthquake and its incidence, its vibrational impact, and structural response are continuously studied for several years in earthquake history and documented in the literature. Since then the structural engineers have tried onerous to look at the procedure, with an aim to counter the complicated dynamic result of seismically generated forces in structures, for designing of earthquake resistant structures in a very refined and simple manner. Main Features of seismic methodology of analysis (Riddell Llera, 1996) (5) based on Indian Standard 1893 (Part I). The method is comparatively easy to be implemented. This permit to identify critical member likely to reach limit states during the earthquake, for which attention ought to be given during the design and detailing method. But this method contains several limited assumptions, which neglects the variation of loading pattern, the influence of higher modes, and the result of resonance.

2. GENERAL CONSIDERATION

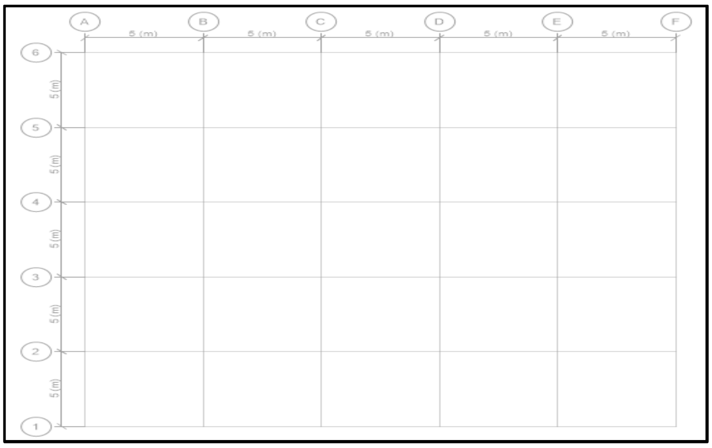

Figure 1 General Plan

2.1. Material Properties

The material is adopted in columns, beams, slabs the M30 grade of concrete is used, while in Rebar Fe500 and Fe415 used for the shear reinforcement.

2.2. Load Definition

Since it is assumed to be the commercial building the Dead load is considered as the weight of the structure while the live load is considered as the 4 kN/m^2 from the ground to the 12th floor while on the roof 1.5 kN/m^2. Brick Masonry is assumed at the periphery of the building

and central core of the building since it is assumed that brick having a density of the 18 kN/m^3 as per the height of the building and the dimension of the brick with plaster load is calculated and applied to the beams as a uniform distributed load.

Apart from the Gravity loads, lateral loads are assumed, Seismic definition is given as per the IS 1893:2002 (part 1)(6) Seismic value is very severe condition which is zone V, response reduction factor is assumed to be 5, assumption is taken that it is the ductile detailing design and Importance factor is taken as 1, while the building soil change and accordingly (Sa/g) value changes. Wind loading is assumed to be the static wind load and is applied on the rigid diaphragms on each floor. The load is calculated according to IS 875:2015 (part 3)(7), Where category 1 and building class A is taken into account.

3. MODELING DETAILS

The plan dimension is taken as 25m x 25m a square grid whereas the height of each story is taken as the 3.3m, Base height is assumed to be the 2.5m, so total height of the structure from the ground floor is 42.9m.

Slabs used are the conventional slabs, hence it is modeled as the membrane element, Shear wall is modeled as the thin shell which is adopted in the corner of building and central core of building, joints in the secondary beams is assumed to be released at the ends, mass source is taken as the (1*DL + 0.5*LL(>3 kN/m2) + 0.5*LL(≤3 kN/m2), Ritz Vector is used in modal analysis, while load combination is generated in through ETABS (8) auto define load combination. All the member size is fixed using hit and trial method since the size where fixed.

4. STRUCTURAL SYSTEM DETAILS

During the project shear wall system is adopted where the dimensions are stated below:

Table 1 Classification of soil

Section	Floor	Size
Primary Beams	GF to 8 8 to 10	450x600 300x600
Secondary Beams	GF to 13	300x500 300x400
Slab	GF to 5 6 to 13	200 180
Column	Base to 6 6 to 13	450x450 600x600
Shear Wall	Base to 8 8 to 13	300 200

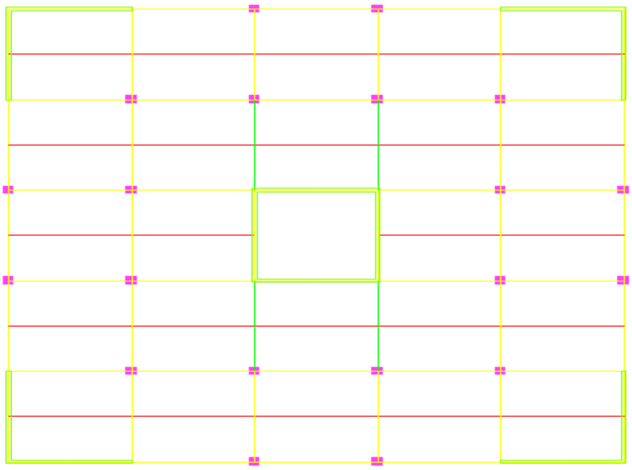

Figure 2 Plan of Shear Wall System

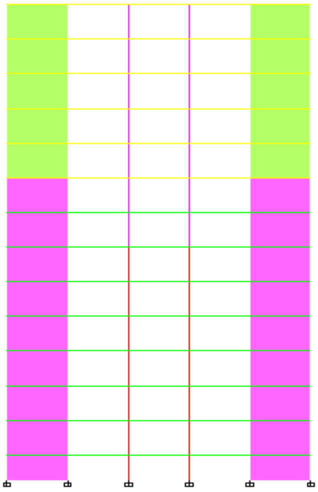

Figure 3 Elevation

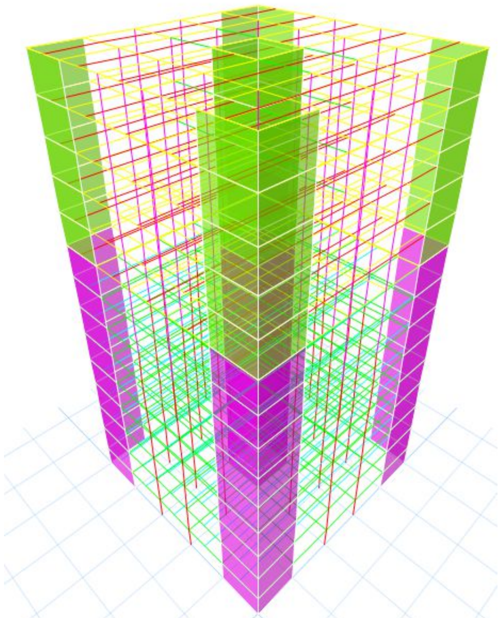

Figure 4 3D view

5. RESULTS

5.1. First Mode Time Period

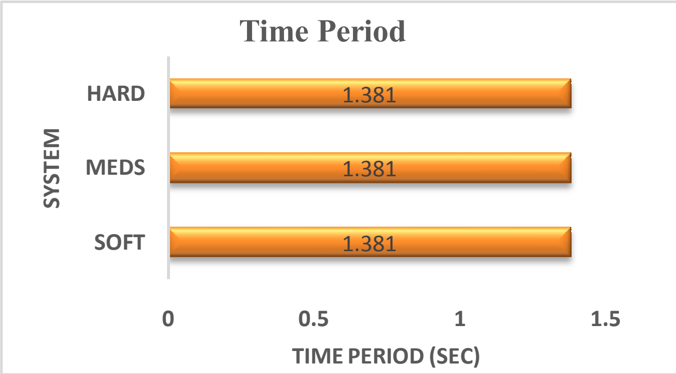

Figure 5 Time period

5.2. Horizontal Seismic Co-efficient (Ah Co-efficient)

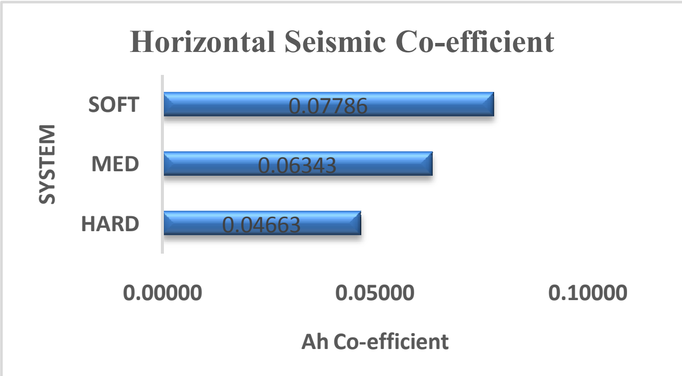

Figure 6 Horizontal Seismic Co-efficient

5.3. Top Story Lateral Displacement

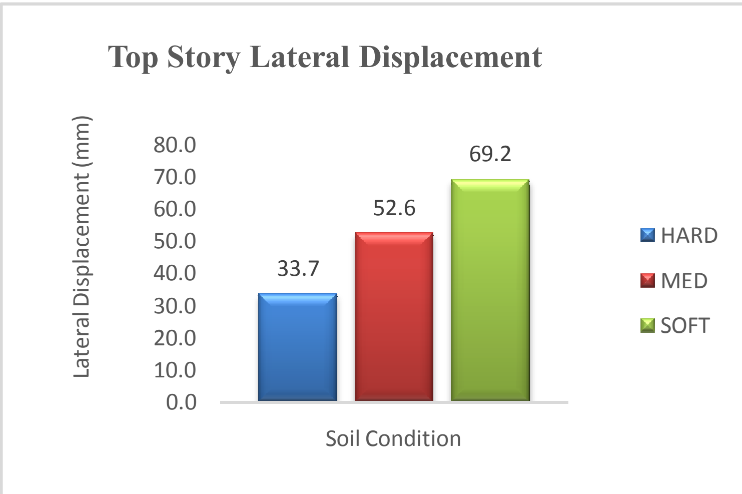

Figure 7 Top Story Lateral Displacement

5.4. Base Shear

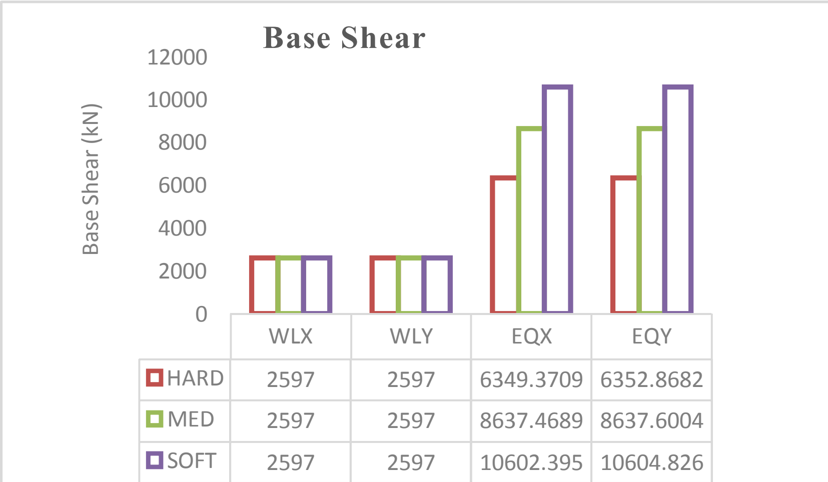

Figure 8 Base Shear

6. CONCLUSION

Time Period: Since the first mode depends on the height and the lateral dimension in the case of infill walls so the time period is not varying in this case.

Horizontal Seismic Coefficient: According to the IS 1893:2002 (part 1) (6), Ah is depending on the soil conditions. Where (Sa/g) is the parameter which varies according to the soil condition.

$$\mathrm{Ah} = \frac{Sa\ I\ Z}{g\ R\ 2}$$

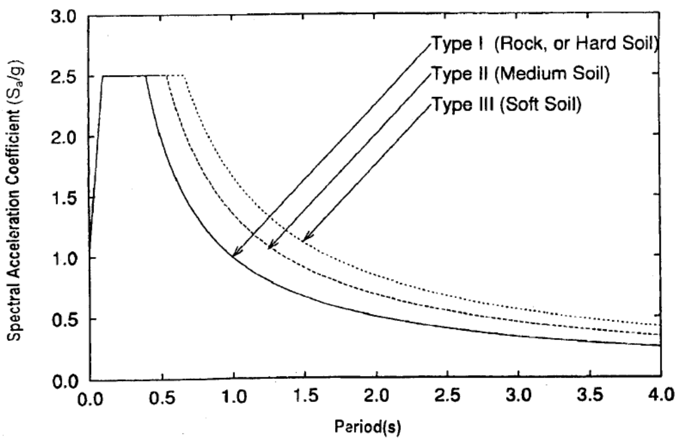

Figure 9 Response Spectra for the Hard, Medium, and Soft Soil

Since in this case, the soft soil is showing more digits while followed by the medium and hard. Which is true in a case of soft soil it governs more force, and due to liquefaction factor, it is prone to seismic force.

Top Story Lateral Displacement: Top story displacement is more in the case of the soft soil while less in the hard soil.

Base Shear: Base shear is more in the case of soft soil and less in the hard soil since because of liquefaction, shear strength is negligible in the case of the soft soil mostly. Since it is very important for the structure to be design accurately and design detailing must be of ductile one (9).

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